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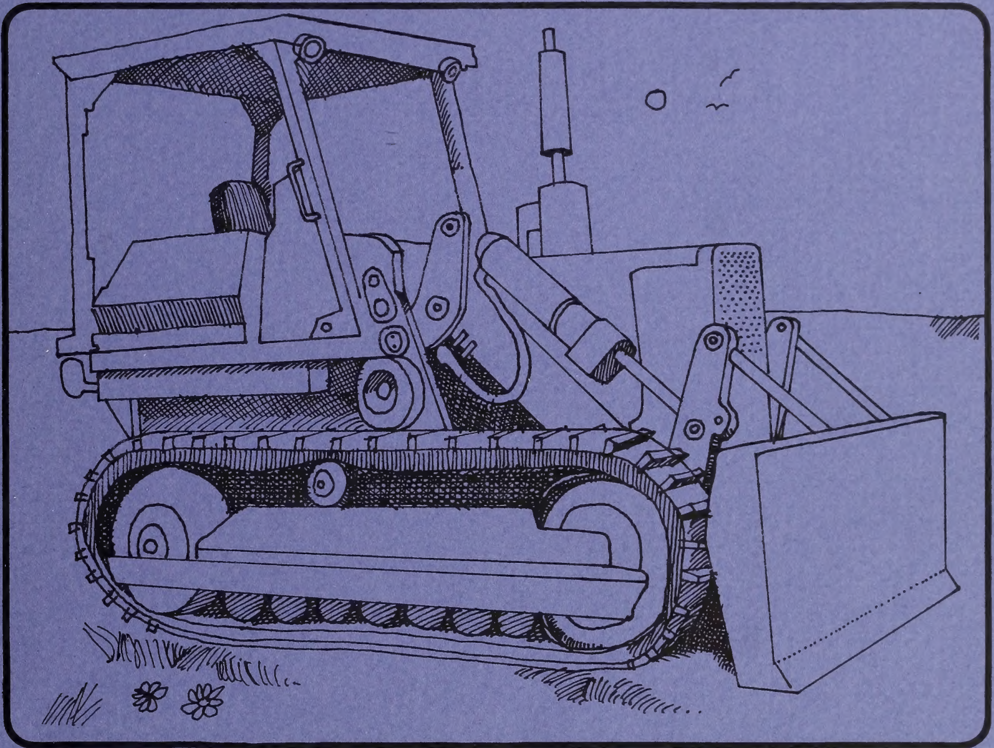
LAND CLEARING AND BREAKING EQUIPMENT COSTS



1984

Alberta
AGRICULTURE
Farm Business
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LAND CLEARING AND BREAKING EQUIPMENT COSTS

by Dennis Dey and Keith Brown
Farm Business Management Branch
Olds, Alberta

Revised Summer, 1984

Alberta
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PREFACE

Clearing and breaking of land in Alberta remain a relatively common practice. These land development projects usually involve significant initial cash outlays and a time delay before full production potential is achieved. The cost of the machinery operations involved in preparing land to reach a productive state is often the major cost component of these projects.

It is the purpose of this publication to assist farmers and custom operators in budgeting for the machine costs involved in land clearing and breaking operations. Worksheets are developed to estimate power unit, implement and attachment costs on a per hour and per acre basis for each type of equipment and for each operation involved. Costs are estimated for a range of equipment sizes (based on spring, 1984 prices), and a survey of custom rates for each operation is reported as a basis for negotiating custom rates and budgeting for clearing and breaking costs. It must be emphasized that these costs are only intended as guidelines. Farmers and custom operators are strongly encouraged to use the worksheets provided when estimating the costs relevant to their own specific situation.

This publication was first prepared in 1980 by Dennis Dey as a summer project at the Farm Business Management Branch under the supervision of Keith Brown. Dennis Dey and Keith Brown also updated this publication in January, 1984 with the assistance of Cal Ausenhus, who helped collect current machinery prices, and Diana Rung, who completed the custom rate survey of land clearing and breaking costs.

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INTRODUCTION

One of the major components of land clearing and breaking projects is the machinery cost involved in clearing land of timber and brush and in breaking this land for cultivation. Before a decision to clear and break land can be evaluated (i.e. cashflow impact, return on investment, payback, etc.), it is necessary to estimate machinery costs.

The results of sound land clearing practices have been outlined in the publication "Land Clearing In British Columbia" as follows:

1. complete removal of all tree growth, except where windbreaks and watercourse protection are required
2. removal of large roots and rocks which will interfere with land breaking and subsequent tillage operations
3. soil-free bush piles to ensure complete burning with the least amount of labor and expense
4. straight well-packed windrows or brush piles placed on a prepared location
5. no excessive loss of topsoil
6. sufficient levelling to permit the use of modern farm equipment
7. reasonable cost per acre in relation to the overall value of the land when finally developed

Various combinations of crawler tractors, wheel tractors, attachments and implements are used to meet these requirements. The intent of this publication is to describe the methods and the machinery commonly used for achieving these results and to provide estimates of the machinery costs involved. Farmers and custom operators who are involved in land development should find this information to be a useful budget guide.

METHODS AND MACHINERY USED TO CLEAR AND BREAK LAND

Land clearing usually proceeds in three stages. The first stage involves removing the tree cover and working it into windrows or piles suitable for future burning. The second stage involves burning these windrows and breaking the land between the windrows. The final stage is a clean-up to repile and burn windrows and to finish breaking land.

Crawler tractors are the primary power source in the first stage since they offer the power, durability, traction and dependability for the heavy work required. Crawler tractors with attachments such as dozer blades, brush cutters and brush rakes utilize a variety of operating methods to clear land of brush (tree cover).

Crawler tractors with dozer blades can walk down trees that range in size from 2-12" in diameter. This method works best in the late fall when the land is dry but not yet frozen, allowing the tree roots to be pulled up or loosened in the walking down.

In areas where tree sizes are smaller, the walking down method becomes less effective. In such areas, tractors equipped with V-type or one-way brush cutters are used to shear or snap off trees at ground level. This "cutting" method is best used in winter when the ground and trees are frozen, since smaller trees will snap off instead of bending over.

Although field patterns for both walking-down or cutting vary with site conditions and operator preference, the primary concern is to operate with the highest level of machine efficiency.

Fallen or cut trees are then pushed at right angles with dozer blades, floating pilers, or brush rakes to form piles or windrows. Floating pilers are similar to dozer blades with teeth that allow soil to pass through, thus minimizing soil in the windrows. Most piling is done in winter to further reduce the soil that is pushed into the piles particularly when dozer blades are being used.

Experienced operators use a rule of thumb where they allow twice as much time for piling as they do for knocking trees down. Since piling involves high machine power requirements, efficient machine use by skilled operators becomes essential for controlling costs.

The second stage in the development process involves breaking the land. Specifically, it relates to the initial working-up of soil once tree cover is removed. Breaking is normally done during the summer, following removal of tree cover. Since farmers want cleared land to be in production as soon as possible, land between windrows (about 80% of the total land to be broken) is usually broken at the same time the piles of cleared timber are drying out.

Implements such as breaking plows, breaking discs or rotary plows are used in land breaking. Although some situations may warrant the use of crawler tractors, wheel tractors are the most common power source. Modern 4-wheel drive tractors are normally able to provide the needed horsepower and can work at higher speeds in the field and during travel between fields.

The choice of implement for breaking land depends on soil type and how trees were removed. Land that has been cleared with a brush cutter is normally plowed with a breaking plow to work under the many roots left in the ground by the cutter. A breaking plow would not normally be used in areas of shallow topsoil because it is critical that plowing does not bring up excessive amounts of subsoil.

A breaking disc is best used where tree cover has been walked down, since roots have already been pulled up and pushed into the piles along with the trees. A breaking disc is likely to bounce over land if a great number of roots have been left by the cutting method of clearing. The benefit of discing is in providing a thorough mixing of the topsoil without bringing up excessive amounts of subsoil.

A rotary plow or large scale rotovator is mainly used to break up pasture land. In areas where land has few stones, the rotary plow is becoming more widely accepted as a breaking implement, although there are concerns about the long-term effects of its use on soil structure. If it is practical to use a rotary plow to break land, one pass will reduce the number of subsequent tillage operations.

The final stage involves getting all the cleared land into seed bed condition. This includes burning windrows, repiling and burning debris, breaking land previously covered by windrows, root-raking, and tilling for seed bed preparation.

After windrows or piles are burned, debris is repiled for further burning or removal. This may mean spreading the debris out to remove soil before repiling in order to achieve a complete burning. Crawler tractors with dozer blades or brush rakes are normally used in repiling work.

Once the windrows have been completely removed, the land they covered is broken in the same manner as the land was broken between the windrows. When it has all been broken, a combination of root raking and tillage will bring the land to seedbed condition. Discing is the most common method of tillage since it provides a level, well-mixed topsoil without bringing roots to the surface. Land broken with a breaking plow requires more discing than land broken with a heavy disc or rotary plow.

Root raking occurs after discing has provided a degree of levelling and before preparation of the final seed bed. Roots lying on the soil surface or partially buried in the soil are worked into windrows with root rakes for subsequent burning or removal. The amount of root raking to be done will depend on the number of roots and the type of root rake used.

Wheel-type root rakes use mechanical or hydraulic power to work roots loose; these rakes provide a degree of levelling in the soil.

The following chart summarizes the operations and machinery required for three common approaches to clearing and breaking land in order to ensure land is ready for final seed bed preparation. The costs of owning and operating this equipment will be developed in subsequent sections.

METHOD I - CUTTING, PILING AND PLOWING

Operation	Power Source	Implement/Attachment
Cutting	Crawler Tractor	Brush Cutter
Piling	Crawler Tractor	Brush Rake
Ploughing (80%)	4-Wheel Drive Tractor	Breaking Plow
Repiling	Crawler Tractor	Brush Rake
Ploughing (20%)	4-Wheel Drive Tractor	Breaking Plow
Discing	4-Wheel Drive Tractor	2 x Wheel Rake or 1 x Drum Rake
Discing	4-Wheel Drive Tractor	Medium Duty Disk

METHOD II - WALKING DOWN, PILING AND DISCING

Operation	Power Source	Implement/Attachment
Walking Down	Crawler Tractor	Dozer Blade
Piling	Crawler Tractor	Dozer Blade
Discing (80%)	4-Wheel Drive Tractor	Breaking Disc
Repiling	Crawler Tractor	Brush Rake
Discing (20%)	4-Wheel Drive Tractor	Breaking Disc
Root Raking	2-Wheel Drive Tractor	2 x Wheel Raker or 1 x Drum Rake
Discing	4-Wheel Drive Tractor	Medium Duty Disc

METHOD III - WALKING DOWN, PILING AND ROTOVATING

Operation	Power Source	Implement/Attachment
Walking Down	Crawler Tractor	Dozer Blade
Piling	Crawler Tractor	Dozer Blade
Rotovating (80%)	4-Wheel Drive Tractor	Rotary Plow
Repiling	Crawler Tractor	Dozer Blade
Rotovating (20%)	4-Wheel Drive Tractor	Rotary Plow
Raking	2-Wheel Drive Tractor	2 x Wheel Raker or 1 x Drum Rake
Discing	4-Wheel Drive Tractor	Medium Duty Disc

ESTIMATED COSTS FOR CRAWLER TRACTORS

Crawler tractors have some unique cost factors not common to other agriculture machinery. While many extension publications deal with estimating costs for typical farm equipment, few deal in detail with estimating costs of crawler tractors. As a planning aid for custom operators and farmers who own (or plan to own) crawler tractors, this section will present cost guidelines and worksheets to estimate crawler tractor costs.

The machinery cost for crawler tractors can be divided into ownership and operating costs. The ownership costs (or fixed costs) include depreciation, interest on investment, and insurance and housing costs. Total ownership costs are fixed for a given period but they vary per hour and per acre within this time period as machine use is increased .

$$\text{Depreciation} = \frac{\text{Purchase Price} - \text{Resale Value}}{\text{Years of Use}}$$

For planning purposes, depreciation can be defined as the loss in value of a machine incurred by the owner during his period of ownership. This cost is only an estimation since calculation of depreciation relies on an estimation of the tractor's future resale value. The condition of a machine is the major factor influencing its resale value, however age, accumulated hours of use, and market demand also affect this value.

A reasonable resale value might be best estimated in consultation with a local dealer. However, the following resale values are a guideline for making this estimation for crawler tractors in reasonable condition, used 2000 hours per year.

Time Period	Resale Value
Year 1	68% Purchase Price
Year 2	63% Purchase Price
Year 3	58% Purchase Price
Year 4	45% Purchase Price
Year 5	40% Purchase Price
Year 6	33% Purchase Price
Year 7	28% Purchase Price

Crawler tractor owners who are constantly involved in land development could consider the replacement cost approach for calculating depreciation. To allow for inflating machinery prices, substitute replacement cost for purchase price in the previous depreciation equation.

Interest On Investment = $\frac{\text{Original Cost + Resale Value}}{2}$ x Interest Rate

Interest on investment is the cost of having money tied up in the machine. This calculation involves determining the average annual capital value of the machine over its life and then applying an interest rate. This interest rate should reflect the opportunity cost of the money (what could be earned elsewhere) as well as any financing costs.

Insurance and Housing Costs = Original Cash Cost x 1%

Crawler tractors used in land clearing projects are considered to be high-risk fire hazards. The high incidence of fire is related to the accumulation of combustible material (i.e. dry twigs, oil and fuel) on a machine that is running hot and operating near fire during burning operations. Adequate insurance coverage for fire and other hazards can cost from $0.75-1.00 per $100 of value. Housing is included as a cost to reflect actual costs incurred or to reflect increased repair costs resulting from lack of housing.

Operating costs (or variable costs) include fuel, lubrication, undercarriage and repairs. They vary in total with machine use, but are constant per hour and per acre.

Fuel Costs Per Hour = Consumption (Litres/Hour) X Price (Dollar/Litre)

The fuel costs for a specific machine can be determined by estimating the rate of consumption under different operating conditions, using the local fuel price in the calculation. As a guide to estimating fuel costs, the following table summarizes data from the Caterpillar Performance Handbook.

FUEL CONSUMPTION IN LITRES (Imperial Gallons)

Machine Size (Horsepower)	Load Conditions					
	Low		Medium		High	
125-150	15	(3.3)	20	(4.3)	25	(5.4)
150-200	22	(4.8)	28	(6.1)	33	(7.3)
200-300	31	(6.8)	40	(8.7)	49	(10.7)
300-400	43	(9.4)	55	(12.0)	68	(14.9)

Source: Caterpillar Performance Handbook. Edition 14

Most land clearing work takes place in the medium- to high-load condition range. A local price for clear diesel fuel can be applied to the consumption rate to determine fuel costs. (e.g. 35¢/litre)

Lubrication Cost Per Hour = Fuel Cost Per Hour X 15%

The cost of lubrication, oil filters and grease are roughly proportional to fuel costs. Experience suggests that lubrication costs are about 15% of fuel costs. (More specific calculations for lubrication costs can be obtained in the Caterpillar Performance Handbook and the Komatsu Specifications And Applications Handbook).

Hourly Undercarriage Cost = (Basic Factor) X (Impact Multiplier + Abrasive Multiplier + Z Factor Multiplier)

Operators of crawler tractors are aware of the necessity and cost of replacing a machine's undercarriage. It is not unusual that replacement costs for rollers, rails and sprockets be up to $20,000 every 2400 hours. Because of their significance and the number of independent factors which can influence them, undercarriage costs are usually separated from other crawler tractor repairs costs.

Field research by the Caterpillar Tractor Company has provided a set of basic factors and condition multipliers to assist in determining an hourly undercarriage cost. The basic factor represents the cost of undercarriage components and shop time for varying machine sizes. The basic factors provided in the Caterpillar Performance Handbook have been adjusted upwards by 20% to reflect higher rates for shop time and higher costs for parts in Alberta.

UNDERCARRIAGE BASIC FACTORS

Machine Size (Horsepower)	Basic Factors (Dollars Per Hour)
125-150	$ 7.20
150-200	8.60
200-300	10.80
300-400	14.40

Source: Caterpillar Performance Handbook. Edition 14.

The condition multipliers represent levels of impact, abrasiveness and a "Z" factor which reflects environmental, operational and maintenance factors. Since these factors all have an effect on the condition of the undercarriage, the multipliers are added and then used to adjust the basic factor to determine an hourly cost.

The following condition multipliers are taken from the Caterpillar Performance Handbook, which relies on extensive field testing to prove reliability.

CONDITION MULTIPLIER

Rating	Impact	Abrasiveness	Z Factor
Low	.1	.1	.2
Medium	.2	.2	.5
High	.3	.4	1.0

Source: Caterpillar Performance Handbook. Edition 14.

The condition multipliers can be determined by estimating the effect on undercarriage condition of the levels of impact, abrasiveness and Z factor (environment, operation and maintenance) the machine will incur.

Basic Repair Cost = Basic Repair Factor x Extended Life Multipliers

The Caterpillar Performance Handbook develops a table of basic repair factors using cost data gathered from the field to provide estimates of machine repair costs. These basic repair costs vary with conditions of machine use and the size of machine. An upward adjustment of 20% has been made to these figures to represent Alberta conditions.

The adjusted figures and extended life multipliers are provided as a basis for repair cost estimates.

BASIC REPAIR RATE (Dollars Per Hour)

Machine Size (Horsepower)	Condition Of Use		
	Low	Medium	High
125-150	4.90	6.20	7.50
150-200	5.70	7.20	8.40
200-300	7.00	8.50	10.40
300-400	9.10	10.70	13.00

If a new machine is used for an extended life (over 10,000 hours of total use) or an old machine is acquired with the intention of using it for an extended life, there will be higher repair costs. These higher repair costs reflect major overhauls as well as the greater frequency of repairs required by older machines. Accordingly, the basic repair rate must be increased when estimating repair costs of older machines.

EXTENDED LIFE MULTIPLIERS

Expected Total Use (Hours)	Multiplier
0 - 10,000	1.0
10,000 - 15,000	1.1
15,000 - 20,000	1.3

Source: Adapted from Caterpillar Performance Handbook, Edition 14.

If, for example, a machine is intended to be used over its life for a total of 13,000 hours, then the basic repair factor would be multiplied by 1.1.

A reconditioned machine has already undergone major repairs; therefore, a practical judgment of whether or not this multiplier should still be applied can be made based on the renewed condition of the machine and its expected use.

A framework has now been developed for estimating the ownership and operating costs of crawler tractors, allowing for the variety of conditions that can affect these costs. These costs will be incurred by the farm manager owning and operating the machine or will be the cost basis for a custom operator in determining a custom charge.

The example presented on the next page gives a cost calculation for a crawler tractor using this approach. This same approach is used to generate the costs for crawler tractors over a range of drawbar horsepower classes.

CRAWLER TRACTOR COST WORKSHEET

Make & Model # ....
Original Cost $.200,000.....
Replacement Cost $.200,000.....
Resale Value $...80,000.....
Interest Rate ....13.....%

Drawbar Horsepower ....180.....DBHP
Annual Hours of Use ..2000.....hrs
Years of Use ....5.........yrs
Condition of Use ..medium......
Fuel Load Condition medium......
Fuel Consumption ......28....... l/hr

Undercarriage Basic Factor $....8.60.........../hr
Impact ......medium..(.2).........
Abrasiveness medium..(.2).........
Z Factor ....medium (.5).........
Basic Repair Rate ....$ 7.20 / hr.........
Extended Life Multiplier .....(1.0)......

		Yearly Cost	Hourly Cost
FIXED COSTS (Calculated on Yearly Basis)			
Depreciation Replacement Cost - Resale Value / Years of Use	= $200,000 - $80,000.. / ..5.. Years	= $ 24,000	
Investment Cost (Original Cash Cost + Resale Value) / 2 X Interest Rate	= ($200,000 + $80,000..) / 2 X .13.% / 100	= $ 18,200	
Insurance & Housing Original Cash Cost X 1%	= $200,000.. X ....13....% / 100	= $ 2,000	
TOTAL FIXED COSTS PER YEAR		$ 44,200 (A)	
TOTAL FIXED COSTS PER HOUR Total Costs Per Year/Hours of Annual Use	= $44,200 ÷ 2000..hrs	=	$ 22.10 (B)
VARIABLE COSTS (Calculated on Hourly Basis)			
Fuel Cost Litre/Hour X Price/Litre	= ....28.....l X $..0.35...	=	$ 9.80
Lubrication Fuel Cost X 15%	= $..9.80.... X ....15.....% / 100	=	$ 1.47
Undercarriage Cost (impact + abrasiveness + Z factor) X Basic Factor	=(.2..+.2..+.5..) X $.8.60	=	$ 7.74
Basic Repair Cost Basic Repair Rate ($/hr) X Extended Life Multiplier	= $..7.20... X ....1.0.....	=	$ 7.20
TOTAL VARIABLE COSTS PER HOUR			$ 26.21 (C)
TOTAL VARIABLE COSTS PER YEAR Total Variable Costs/Hour X Hours of Annual Use	= $..26.21... X 2000..hrs	$ 52,420 (D)	
TOTAL COSTS PER YEAR (A+D) =	$44,200 + $52,420	$ 96,620	
TOTAL COSTS PER HOUR (B+C) =	$..22.10.. + $.26.21..		$ 48.31

ESTIMATED COSTS FOR CRAWLER TRACTORS

Size DB HP	Annual Hours Use	Diesel Use 1/Hr	Current Replace Cost $	Fixed Cost $/Hr	Variable Cost $/Hr	Total Machine Cost $/Hr	Labor Cost $/Hr	Custom Charge Cost Basis $/Hr	Custom Rate Survey Jan 1984 $/Hr	Alberta Transport Rates 1983-84 $/Hr
125 - 150	1500	20	150000	22.10	20.73	42.83	13.00	55.83	Common 60-65	$50 - 60
	2000			16.58	20.73	37.31	13.00	50.31	Range	
	2500			13.26	21.35	34.61	13.00	47.61	45-75	
150 - 200	1500	28	200000	29.47	26.21	55.68	13.00	68.68	Common 65-75	$60 - 70
	2000			22.10	26.21	48.31	13.00	61.31	Range	
	2500			17.68	26.93	44.61	13.00	57.61	40-80	
200 - 300	1500	40	275000	40.52	34.32	74.84	13.00	87.84	Common 65-85	$75 - 90
	2000			30.39	34.32	64.71	13.00	77.71	Range	
	2500			24.31	35.17	59.48	13.00	72.48	65-85	
300 - 400	1500	55	380000	55.99	45.80	101.78	13.00	114.78	Common 110-120	$90 - 100
	2000			41.99	45.80	87.79	13.00	100.79	Range	
	2500			33.59	46.87	80.46	13.00	93.46	90-135	

Assumes:
- Five years of ownership.
- Resale value at 40% of purchase price (see page 6).
- Interest rate at 13%.
- Clear diesel fuel at 35¢/litre.
- "Medium" condition of use for basic repair rates and undercarriage repair condition multipliers.
- Annual hours of use at 1500, 2000 and 2500 hours.

Note:
- 2500 hours of annual use require an extended life multiplier of 1.1 for the basic repair rate (i.e. 2500 hours x 5 years = 12,500 hours of accumulated use).
- No margin has been allowed for profit (in excess of a 13% return to money invested) in the Custom Charge Cost Basis calculation.
- The manufacturers model classification according to the range of DBHP presented are listed in the following table.
- Fixed Costs = Depreciation + Interest + Insurance & Housing
- Variable Costs = Fuel + Lubrication + Undercarriage + Repairs & Maintenance.

CLASSIFICATION OF MODELS BY DRAWBAR HORSEPOWER CLASS

Manufacturer	125-150 DBHP	150-200	200-300	300-400
CASE	1450,1450B			
CATAPILLAR (Series)	D6C Series	D7E,D7F	D7G,D8H	D8K,D8H,D9G
FIAT	HD11B,HD11EC, HD11BPS,HD11EP, HD16A	FD14C,HD16A, HD16ACTC,HD16D, HD16DCTC,HD16FC, HD16BDD,HD16BPS, HD16PCTC,HD16DP, HD16DP	FD20,HD16B, HD21,HD21A,21B	FD30,21CPS, HD21P,HD21PPS, HD21B
INTERNATIONAL	TD15B,TD15C	TD20B,TD20C	TD20E,TD25B, TD25C	TD25C,TD25E
JOHN DEERE	JD850			
KOMATSU	D60A-3,D60A-6, D60E-3,D60P-3, D60P-6,D60PL-6, D65A-6	D60E-6,D60P-6, D65P-6,D65P-6, D65E-6,D80A-8, D80A-12,D85E-12	D80A-18,D80E-12, D80E-18,D85A-12, D85A-18,D85E-12, D85P-18,D85E-18, D120A-18,D125A-18	D150A,D155A
MASSEY FERGUSON	MF500,MF500B, MFD600CD	MFD750C	82-30,82-20B,82-40, 82-40T,82-30B	
TEREX	D600D	82-20	D700D	82-50

Source: Adapted from Alberta Transportation, Schedule of Rental Rates for Construction Equipment 1983-1984, Pages 8-31.

ESTIMATED COSTS FOR WHEEL TRACTORS

The ownership and operating costs of wheel tractors can be calculated in a manner similar to that used for crawler tractors. A worksheet is provided in the back of this publication for anyone wishing to calculate their own specific machine costs.

ESTIMATED COSTS FOR 4 WHEEL DRIVE TRACTORS

4WD Engine HP	Annual Hours Use	Diesel Use	Current Replace Cost	Fixed Cost	Variable Cost	Total Machine Cost
		litres/Hr	$	$/Hr	$/Hr	$/Hr
175	400	34	67000	25.25	15.08	40.33
	600			16.83		31.91
	1000			10.10		25.18
220	400	40	80000	30.15	17.80	47.95
	600			20.10		37.90
	1000			12.06		29.86
250	400	50	88000	33.16	21.65	54.81
	600			22.11		43.76
	1000			13.26		34.91
275	400	53	105000	39.57	23.54	63.10
	600			26.38		49.91
	1000			15.83		39.36
300	400	58	115000	43.34	25.76	69.10
	600			28.89		54.65
	1000			17.33		43.09
350	400	62	125000	47.10	27.64	74.74
	600			31.40		59.04
	1000			18.84		46.48
450	400	85	150000	56.52	36.83	93.35
	600			37.68		74.51
	1000			22.61		59.43

Assumes:
- 13 years of use (ownership).
- Resale value at 10% of purchase price (at 13 years).
- Interest rate at 13%.
- Diesel fuel at 30¢/litre and purple gas @ 31¢/litre.
- Annual repairs at 3% of purchase price.
- Annual hours of use at 400, 600 and 1,000.

Note:
- 600 Annual Hours of use is the basis used for costing tractor-driven operations.
- Labor is not included in total machine costs but will be included in the cost of each operation.
- 350 and 450 HP tractors are costed without PTO.
- Fixed Costs = Depreciation, Interest on Investment, Insurance & Housing
- Variable Cost = Fuel, Lubrication, Repairs & Maintenance

ESTIMATED COSTS FOR 2 WHEEL DRIVE TRACTORS

2WD PTO HP	Annual Hours Use	Diesel Use	Current Replace Cost	Fixed Cost	Variable Cost	Total Machine Cost
		litres/Hr	$	$/Hr	$/Hr	$/Hr
40	400	8	18000	6.78	3.66	10.44
	600			4.52		8.18
	1000			2.71		6.37
60	400	13	23000	8.67	5.64	14.30
	600			5.78		11.41
	1000			3.47		9.10
80	400	17	30000	11.30	7.37	18.67
	600			7.54		14.90
	1000			4.52		11.89
100	400	22	50000	18.84	10.09	28.93
	600			12.56		22.65
	1000			7.54		17.63
120	400	28	55000	20.73	12.41	33.14
	600			13.82		26.23
	1000			8.29		20.70
140	400	32	61000	22.99	14.09	37.08
	600			15.32		29.41
	1000			9.19		23.28
160	400	38	68000	25.62	16.51	42.13
	600			17.08		33.59
	1000			10.25		26.76
180	400	39	73000	27.51	17.11	44.61
	600			18.34		35.44
	1000			11.00		28.11

Assumes:
- 13 years of use (ownership).
- Resale value at 10% of purchase price (at 13 years).
- Interest rate at 13%.
- Diesel fuel at 30¢/litre and purple gas @ 31¢/litre.
- Annual repairs at 3% of purchase price.
- Annual hours of use at 400, 600 and 1,000.

Note:
- 600 Annual Hours of use is the basis used for costing tractor-driven operations.
- Labor is not included in total machine costs but will be included in the cost of each operation.
- Fixed Costs = Depreciation + Interest + Insurance & Housing
- Variable Costs = Fuel + Lubrication + Repairs & Maintenance

ESTIMATED COSTS FOR IMPLEMENTS AND ATTACHMENTS

Cost calculations for crawler tractors include dozer blades as a standard part of the tractor, however other attachments and implements used in land clearing have their own separate costs.

Attachment and implement costs are calculated below using the machinery cost worksheet. Assumptions regarding life, interest rate and annual repair rate in the following tables are made in order to complete the calculations.

ESTIMATED COSTS FOR ATTACHMENT

Attachments	Crawler Tractor DB HP	Annual Hours Use Hrs/Yr	Current Replace Cost $	Fixed Cost $/Hr	Variable Cost $/Hr	Total Machine Costs $/Hr
FLOATING PILER			Repair Rate = 4 % Purchase Price/100 Hrs			
14 Foot	125	250	10500	8.17	4.20	12.37
	125	500	10500	4.08	4.20	8.28
16 Foot	150	250	11800	9.18	4.72	13.90
	150	500	11800	4.59	4.72	9.31
18 Foot	200	250	12700	9.88	5.08	14.96
	200	500	12700	4.94	5.08	10.02
20 Foot	300	250	14000	10.89	5.60	16.49
	300	500	14000	5.45	5.60	11.05
24 Foot	400	250	21000	16.34	8.40	24.74
	400	500	21000	8.17	8.40	16.57
VEE TYPE BRUSH CUTTER			Repair Rate = 4 % Purchase Price/100 Hrs			
15 Foot	200	250	18500	14.39	7.40	21.79
	200	500	18500	7.20	7.40	14.60
16 Foot	200	250	21000	16.34	8.40	24.74
	200	500	21000	8.17	8.40	16.57
18 Foot	300	250	27000	21.01	10.80	31.81
	300	500	27000	10.50	10.80	21.30
20 Foot	400	250	32000	24.90	12.80	37.70
	400	500	32000	12.45	12.80	25.25

Assumes:
- Interest at 13%.
- Resale value at 10%.
- Years of life at 7 years.
- Hours of annual use and repairs as indicated in table.

ESTIMATED COSTS FOR IMPLEMENTS

Implement	Wheel Tractor	Annual Hours Use	Current Replace Cost	Fixed Cost	Variable Cost	Total Machine Costs
	HP	Hrs/Yr	$	$/Hr	$/Hr	$/Hr
WHEEL ROOT RAKE			Repair Rate = 5 % Purchase Price/100 Hrs			
5 Wheel	80	100	12500	24.31	6.25	30.56
	80	300	12500	8.10	6.25	14.35
7 Wheel	80	100	14900	28.98	7.45	36.43
	80	300	14900	9.66	7.45	17.11
DRUM TYPE ROOT RAKE			Repair Rate = 5 % Purchase Price/100 Hrs			
12 Foot	110	100	31350	60.98	15.68	76.65
	110	200	31350	30.49	15.68	46.16
	110	300	31350	20.33	15.68	36.00
BREAKING PLOW			Repair Rate = 5 % Purchase Price/100 Hrs			
2 Bottom	140	150	14700	19.06	7.35	26.41
	140	300	14700	9.53	7.35	16.88
3 Bottom	120 - 180	150	24500	31.77	12.25	44.02
	120 - 180	300	24500	15.88	12.25	28.13
4 Bottom	160 - 240	150	30500	39.55	15.25	54.80
	160 - 240	300	30500	19.77	15.25	35.02
DISCS (MEDIUM DUTY)			Repair Rate = 4 % Purchase Price/100 Hrs			
16 Ft Tandem	120	150	11000	14.26	4.40	18.66
	120	250	11000	8.56	4.40	12.96
23 Ft Tandem	140	150	18500	23.99	7.40	31.39
	140	250	18500	14.39	7.40	21.79
12 Ft Offset	140	150	10500	13.62	4.20	17.82
	140	250	10500	8.17	4.20	12.37
14 Ft Offset	180	150	11500	14.91	3.07	17.98
	180	250	11500	8.95	1.84	10.79
BREAKING DISC			Repair Rate = 4.5 % Purchase/100 Hrs			
10 Ft Offset	200	250	19000	14.78	8.55	23.33
	200	500	19000	7.39	8.55	15.94
11 Ft Offset	250	250	22000	17.12	9.90	27.02
	250	500	22000	8.56	9.90	18.46
12 Ft Offset	275	250	25000	19.45	11.25	30.70
	275	500	25000	9.73	11.25	20.98
ROTARY PLOW			Repair Rate = 6 % Purchase Price/100 Hrs			
7.5 Ft - 435 Hp	200	500	147500	57.38	88.50	145.88
	200	1000	147500	28.69	88.50	117.19
	200	1500	147500	19.13	88.50	107.63

Assumes:
- Interest at 13%
- Resale value at 10%
- Years of life at 7 years.
- Hours of annual use and repairs as indicated in table.

ESTIMATED COSTS FOR CLEARING AND BREAKING OPERATIONS

Up to this point, the hourly machinery ownership costs and operating costs of equipment used in land clearing have been estimated. The full hourly cost of each land clearing operation can now be found by adding a labor charge to the combined costs of machinery being used. A per acre development cost for a parcel of land can now be estimated by relating field operating capacities to these hourly operating costs.

A number of factors will influence the combinations of equipment used in a particular procedure. These include power requirements, local conditions and availability of equipment and operators. Basic power requirements for attachments and implements have been assumed in the following cost calculations. While these basic power requirements account mainly for the size of implement or attachment being used, other local factors such as field operating conditions (heavy soil and gumbo) must also be considered when estimating the power source to be used.

For these calculations, crawler tractor labor costs are estimated at $13 per hour while wheel tractor labor is charged at $7.50 per hour. Crawler tractor operators earn more because of the complexity of a crawler tractor, because they are subjected to more extreme working conditions and because they require more skills in order to operate such a machine efficiently.

Machine capacity is influenced by physical factors such as operating speed, machine size, operator efficiency, soil type, tree cover and topography. Estimations of capacity can be obtained from experienced operators when specific conditions are known.

The following summary provides a basis for estimating land development costs using data on machinery costs, labor costs and operating capacity. When more specific details are known, the same method can be used for each individual situation.

ESTIMATED COSTS FOR CLEARING AND BREAKING OPERATIONS

Procedure	Power Unit Required	Power Unit Cost	Attach. Or Implem. Cost	Labor Cost	Custom Charge Cost Basis	Capacity Low	Capacity High	Cost Basis Per Acre High	Cost Basis Per Acre Low	Custom Rate Survey
	DB HP	$/Hr	$/Hr	$/Hr	$/Hr	Ac/Hr		$/Ac		Jan 1984
WALKING DOWN										Common $100-130 Per Acre
13 Foot Dozer	200	48.31	Incl.	13.00	61.31	1.0	1.5	61.31	40.87	
14 Foot Dozer	300	64.71	Incl.	13.00	77.71	1.5	2.0	51.81	38.86	
16 Foot Dozer	400	87.97	Incl.	13.00	100.97	1.8	2.5	56.09	40.39	
CUTTING										
15 Foot Cutter	200	48.31	14.60	13.00	75.91	1.0	1.5	75.91	50.61	
18 Foot Cutter	300	64.71	21.30	13.00	99.01	1.5	2.0	66.01	49.51	
20 Foot Cutter	400	87.97	25.25	13.00	126.22	1.7	2.5	74.25	50.49	
PILING										
13 Foot Dozer	200	48.31	Incl.	13.00	61.31	0.6	0.8	102.18	76.64	
14 Foot Dozer	300	64.71	Incl.	13.00	77.71	0.8	1.2	97.14	64.76	
16 Foot Dozer	400	87.79	Incl.	13.00	100.79	1.0	1.5	100.79	67.19	
18 Foot Piler	200	48.31	10.02	13.00	71.33	0.8	1.2	89.16	59.44	
20 Foot Piler	300	64.71	11.05	13.00	88.76	1.0	1.5	88.76	59.17	
24 Foot Piler	400	87.79	16.57	13.00	117.36	1.2	1.8	97.80	65.20	
REPILING										
11 Foot Dozer	150	37.31	Incl.	13.00	50.31	2.0	3.0	25.16	16.77	
13 Foot Dozer	200	48.31	Incl.	13.00	61.31	3.0	4.0	20.44	15.32	
14 Foot Piler	150	37.31	8.28	13.00	58.59	2.0	4.0	29.30	14.65	
18 Foot Piler	200	48.31	9.31	13.00	70.62	4.0	5.0	17.66	14.12	
BREAKING										
2 Bottom Plow	140	29.41	16.88	7.50	53.79	1.5	2.0	35.86	26.90	$35-$45 Per Acre 2 Passes
3 Bottom Plow	175	31.91	28.13	7.50	67.54	2.5	3.0	27.02	22.51	
4 Bottom Plow	220	37.90	35.02	7.50	80.42	3.5	4.0	22.98	20.11	
10 Ft Offset Disc	220	37.90	15.94	7.50	61.34	4.0	5.0	15.34	12.27	
11 Ft Offset Disc	250	43.76	18.46	7.50	69.72	5.0	6.0	13.94	11.62	
12 Ft Offset Disc	275	49.91	20.98	7.50	78.39	6.0	7.0	13.07	11.20	
Rotary Plow	220	37.90	107.63	7.50	153.03	1.0	1.5	153.03	102.02	$70/Acre
ROOT RAKING										
5 Wheel Rake	60	11.41	14.35	7.50	33.26	4.0	6.0	8.32	5.54	$10/Acre
7 Wheel Rake	80	14.90	17.11	7.50	39.51	6.0	8.0	6.59	4.94	
12 Ft Drum Rake	120	26.23	36.00	7.50	69.73	2.0	3.0	34.87	23.24	
TILLAGE BY MEDIUM DUTY DISC										
16 Ft Tandem Disc	120	26.23	12.96	7.50	46.69	7.0	9.0	6.67	5.19	$5.50-$7 Per Acre
23 Ft Tandem Disc	140	29.41	21.79	7.50	58.70	11.0	14.0	5.34	4.19	
12 Ft Offset Disc	140	29.41	12.37	7.50	49.28	6.0	7.0	8.21	7.04	
14 Ft Offset Disc	180	35.44	10.79	7.50	53.73	7.0	9.0	7.68	5.97	

Assume: - Labor for crawlers at $13 per hour, for wheel tractors at $7.50 per hour.

Note:
- No margin has been allowed for profit to custom operator (in excess of a 13% return on money invested).
- Breaking is done with a heavy-duty breaking disc whereas tillage by disc uses a regular medium-duty disc.
- Costs are for one pass only.

APPLYING THIS INFORMATION

What has been outlined so far has been the use of cost analysis to determine ownership and operating costs of machinery. As well, these costs have been combined to form the cost of each land clearing operation. For a specific land development cost analysis, it will be necessary to determine such information as the amount of land involved, local custom rates, the clearing method used and physical conditions that affect costs. The land development costs for that land can then be estimated accordingly.

Consider a situation involving the development of medium to heavy bush-covered land. The operations involved would be walking down, piling and breaking with a breaking disc. Using the information in this publication, a cost estimate would be developed as follows.

METHOD: WALKING DOWN, PILING AND DISCING

Procedure	Cost Range	Cost Estimate
Walking Down		
14' Dozer Blade, 300 HP Crawler	$39-52/acre	$45/acre
Piling		
14' Dozer Blade, 300 HP Crawler	$65-97/acre	$80/acre
Breaking		
12' Offset Breeding Disc, 275 HP Wheel	$11-13/acre	$12/acre
Repiling		
13' Dozer Blade, 200 HP Crawler	$15-20/acre	$18/acre
Discing Two Times		
12' Medium Offset, 140 HP Wheel	$ 7-8/acre	$ 8/acre
Root Raking		
5 Wheel Rake, 60 HP Wheel	$ 6-8/acre	$ 7/acre
Two Times		$ 7/acre
Discing		
12' Medium Offset Disc, 140 HP Wheel	$ 7-8/acre	$ 8/acre
TOTAL ESTIMATED COST		$187/acre

1984 LAND CLEARING AND BREAKING CUSTOM RATES SURVEY RESULTS

The following data on land clearing and breaking rates are based on a survey that was conducted by Alberta Agriculture in January, 1984. Approximately 60 contacts were made throughout the province, and the results were tabulated on a cost per acre basis.

		Cost Per Acre	
Region	Operation	Range	Most Common
South	Cutting, piling & other cat work	$70-$150	$90-$120
	Discing	$30-$60	$40-$45
	Plowing	$20-$30	$25
	Root Raking	$10-$15	$10
Central	Cutting, piling & other cat work	$70-$160	$100-$130
	Discing	$30-$50	$35-$45
	Plowing	$30-$40	$35
North	Cutting, piling & other cat work	$75-$150	$100-$135
	Discing	$30-$65	$40-$45
	Plowing	$30-$40	$35
	Root Raking	$10-$15	$10

The south region of Alberta is the area from Olds south to the American border; the central region is the area from Olds north to Edmonton; and the north region is the area north of Edmonton and includes the Peace River region.

SUMMARY

This publication provides the following information in order to make a decision to clear and break land.

1. An overview of methods and procedures which can be used in land clearing.
2. A means of calculating ownership and operating costs for crawler tractors.
3. Estimated costs for crawler tractors, wheel tractors, attachments and implements used to clear and break land.
4. Summary costs for each land clearing and breaking operation and custom rates for these same operations.

This information is intended to aid in the decision making process to budget for land development projects or to negotiate a charge for custom work.

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APPENDIX I

CRAWLER TRACTOR COST WORKSHEET

Make & Model # ....

Original Cost $.....................

Replacement Cost $.....................

Resale Value $.....................

Interest Rate ....%

Drawbar Horsepower ....DBHP

Annual Hours of Use ....hrs

Years of Use ....yrs

Condition of Use ....

Fuel Load Condition ....

Fuel Consumption .... l/hr

Undercarriage Basic Factor $................/hr

Impact ....

Abrasiveness ....

Z Factor ....

Basic Repair Rate ....

Extended Life Multiplier ....

Yearly Cost | Hourly Cost

FIXED COSTS (Calculated on Yearly Basis)

Depreciation

$\frac{\text{Replacement Cost - Resale Value}}{\text{Years of Use}}$ = $\frac{\$........... - \$...........}{...... \text{ Years}}$ = $ ________

Investment Cost

$\frac{\text{Original Cash Cost + Resale Value}}{2}$ X Interest Rate = $\frac{(\$......... + \$..........)}{2}$ X $\frac{.....\%}{100}$ = $ ________

Insurance & Housing Original Cash Cost X 1% = $............ X $\frac{..........\%}{100}$ = $ ________

TOTAL FIXED COSTS PER YEAR $ ________ (A)

TOTAL FIXED COSTS PER HOUR

Total Costs Per Year/Hours of Annual Use = $.......... ÷ ....hrs = $ ________ (B)

VARIABLE COSTS (Calculated on Hourly Basis)

Fuel Cost Litre/Hour X Price/Litre = ...l X $........... = $ ________

Lubrication Fuel Cost X 15% = $........... X $\frac{...........\%}{100}$ = $ ________

Undercarriage Cost

(impact + abrasiveness + Z factor) X Basic Factor =(.....+.....+......) X $....... = $ ________

Basic Repair Cost

Basic Repair Rate ($/hr) X Extended Life Multiplier = $........... X .... = $ ________

TOTAL VARIABLE COSTS PER HOUR $ ________ (C)

TOTAL VARIABLE COSTS PER YEAR

Total Variable Costs/Hour X Hours of Annual Use = $........... X ....hrs $ ________ (D)

TOTAL COSTS PER YEAR (A+D) = $........... + $........... $ ________

TOTAL COSTS PER HOUR (B+C) = $........... + $........... $ ________

APPENDIX II

MACHINERY COST WORKSHEET

Machine. . . . .**Original Cost** . . . .**Annual Hours Use** . . . .

Replacement Cost . . . .**Sale Value** . . . .**Years of Use**. . . . .

	Yearly Cost	Hourly Cost

FIXED COSTS (Calculated on Yearly Basis)

1. Depreciation =

$$\frac{\text{Replacement Cost} - \text{Cash Sale Value}}{\text{Years of Use}}$$

$$= \frac{\$\ldots\ldots\ldots\ldots - \$\ldots\ldots\ldots\ldots}{\ldots\ldots\text{ years}} =$$

Yearly Cost: $ ________

2. Investment Cost =

$$\frac{\text{Original Cash Cost} + \text{Cash Sale Value}}{2} \times \text{Interest Rate}$$

$$= \frac{\$\ldots\ldots\ldots\ldots + \$\ldots\ldots\ldots\ldots}{2} \times \ldots\ldots\ldots\ldots\% =$$

Yearly Cost: $ ________

3. Insurance & Housing = Original Cash Cost X 1%

= $. . . . . X . . . . % = $ ________

4. TOTAL FIXED COSTS PER YEAR $ ________(A)

5. TOTAL FIXED COSTS/HOUR = Total Costs Per Year/Hours of Annual Use

= $. . . . . ÷ . . . . hr = $ ________(B)

VARIABLE COSTS (Calculated on Hourly Basis)
(use following formulas if actual costs are not known)

1. Fuel Cost = Gal/hr (Fully Loaded) X Price Per Gallon X Load Factor (%)

= . . . . X $. . . . . X . . . . % = $ ________

2. Lubrication = Fuel Cost X 15%

= $. . . . . . . X . . . . . .% = $ ________

3. Repairs =

$$\frac{\text{Original Purchase Price} \times \text{Annual Repair Rate}}{\text{Hours of Annual Use}}$$

$$= \frac{\$\ldots\ldots\ldots\ldots \times \ldots\ldots\ldots\ldots\%}{\ldots\ldots\text{ hours}} =$$

Hourly Cost: $ ________

4. TOTAL VARIABLE COSTS PER HOUR $ ________(C)

5. TOTAL VARIABLE COSTS PER YEAR = Total Variable Costs/Hour X Hours of Annual Use

= $. . . . . X. . . . . hr = $ ________(D)

TOTAL COSTS PER YEAR (A + D) = $. . . . . + $. . . . . = $ ________

TOTAL COSTS PER HOUR (B + C) = $. . . . . + $. . . . . = $ ________

N.L.C. - B.N.C.
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